

Hillside Feedback Loop

Use field data to trace linked Earth-system changes.

HS-ESS2-2 "Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. Clarification Statement: Examples should include climate feedbacks..."

NAME _____

DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Underline each measured observation in the passage. Then number the changes in the feedback chain, starting with 1 at the surface change, so you can use evidence to support a claim.

A Changing Valley

- ① This classroom simulation uses invented field measurements. In a semi-arid valley, satellite images from 2005 and 2025 showed that ground vegetation covered 62 percent of a hillslope at first and 29 percent later. During the same period, average yearly runoff measured at a stream gauge rose from 18 to 31 centimeters. Soil traps at the bottom of the slope collected more sediment after heavy storms. Vegetation normally slows moving water, lets some water soak into the ground, and holds soil with roots. When shrubs and grasses were removed by repeated overgrazing, rainwater traveled downhill faster. The data connect a surface change, vegetation loss, to changes in the water and geosphere systems.
- ② Faster runoff did more than carry soil away. As erosion removed the darker, organic-rich topsoil, the slope stored less water after rain. With less water available near the surface, fewer plant seeds germinated during dry weeks. A field survey found 14 seedlings per square meter on the more eroded section, compared with 37 on a nearby section where topsoil remained. Fewer new plants meant less cover to slow later storms. Thus, the original loss of vegetation increased runoff and erosion, and those changes made it harder for vegetation to return. This is a positive feedback because the effects strengthen the initial surface change.

- ③ The effects can spread beyond the hillside. The extra sediment makes stream water muddy and can settle in channels downstream. A shallow channel carries less water before it overflows, so floods may reach nearby fields more often. The changes also affect people who use the valley. Farmers may lose fertile soil from their land, while a town may need to remove sediment from a water-storage reservoir. These observations support a claim about linked Earth systems, not simply a claim that erosion happened. The data show a chain: a biosphere change altered water movement, which changed soil and sediment in the geosphere, with further consequences for living things and human communities.

2 ANSWER WITH EVIDENCE _____ Use the passage

- ① What was the first surface change in the valley, and which two numerical observations show that conditions changed after it?

- ② Write the feedback chain from vegetation loss to conditions that make vegetation recovery harder. Include at least four linked changes.

- ③ Why does the passage describe this process as a positive feedback? Use one piece of passage evidence in your answer.

- 4** Write one evidence-based claim explaining how the loss of ground vegetation changed more than one Earth system. Cite two details from the passage.

3 YOUR TURN _____ Your own words

In a simulated Pine Marsh record, wetland area fell from 120 to 45 hectares after drainage, afternoon relative humidity fell from 68% to 54%, and the water table deepened from 0.6 to 1.3 meters below the surface. Drier air can speed evaporation when water remains available. In four sentences, use the trends to propose a feedback that could reinforce drying, distinguish it from a proven cause, and name an additional measurement that would test the mechanism.

[illegible]

PART 1 • READ AND MARK

Underline each measured observation in the passage. Then number the changes in the feedback chain, starting with 1 at the surface change, so you can use evidence to support a claim. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	What was the first surface change in the valley, and which two numerical observations show that conditions changed after it?	The first surface change was loss of ground vegetation. Vegetation cover fell from 62 percent to 29 percent, and yearly runoff rose from 18 to 31 centimeters.
2	Write the feedback chain from vegetation loss to conditions that make vegetation recovery harder. Include at least four linked changes.	Vegetation loss led to faster runoff, which increased erosion and topsoil loss, which reduced water stored near the surface and seed germination, which produced less vegetation cover.
3	Why does the passage describe this process as a positive feedback? Use one piece of passage evidence in your answer.	It is a positive feedback because vegetation loss causes runoff and erosion, and erosion makes it harder for new plants to grow, strengthening the original vegetation loss.
4	Write one evidence-based claim explaining how the loss of ground vegetation changed more than one Earth system. Cite two details from the passage.	The loss of ground vegetation affected the biosphere, hydrosphere, and geosphere because runoff rose from 18 to 31 centimeters and erosion removed topsoil, reducing seedling growth.

PART 3 · YOUR TURN (SAMPLE ANSWER)

The simulated wetland shrank from 120 to 45 hectares while relative humidity fell from 68% to 54% and the water table deepened from 0.6 to 1.3 meters. One possible reinforcing loop is that wetland loss reduces local moisture input, while drier air speeds water loss from remaining wet surfaces and encourages further drying. These associated trends do not prove that loop, because drainage or weather could also change the measurements. Repeated evaporation, rainfall, temperature and drainage-flow measurements at comparable drained and undrained sites would help test the proposed links.

Accept accurate biosphere-hydrosphere-geosphere links supported by the simulated measurements. All valley and marsh numbers are invented instructional data. For Pine Marsh, require the three trends, a plausible reinforcing mechanism, an explicit limit on causal inference and useful additional evidence. Do not treat reduced humidity alone as proof that local rainfall decreased or that any one feedback caused the wetland loss.